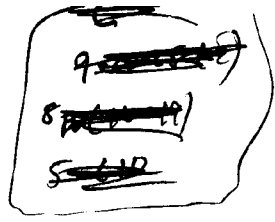


Part A: Problem #1



①

Region 1:  $r < a$

$$\vec{E} = 0 \rightarrow \text{no charge enclosed}$$

Region 2:  $a < r < b$

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{\text{enc}}}{\epsilon_0} \quad Q_{\text{enc}} = \int \rho_s ds$$
$$E_r 4\pi r^2 = \frac{4\pi a^2 (5k)}{\epsilon_0}$$

$$\vec{E} = \frac{5ka^2}{r^2 \epsilon_0} \hat{r}$$

Region 3:  $b < r < c$

$$\vec{E} = 0 \rightarrow \text{by definition of conductor}$$

Region 4:

$$r > c$$
$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{\text{enc}}}{\epsilon_0}$$

See Region 2 solution

$$\vec{E} = \frac{5ka^2}{r^2 \epsilon_0} \hat{r}$$

Region 4:  $r > c$ Find  $V$ 

$$\begin{aligned}
 V &= -\int \vec{E} \cdot d\vec{l} \\
 &= -\int_{\infty}^r \frac{5ka^2}{r^2 \epsilon_0} dr \\
 &= \frac{5ka^2}{r \epsilon_0} \Big|_{\infty}^r = \frac{5ka^2}{r \epsilon_0}
 \end{aligned}$$

Region 3  $b < r < c$ Using boundary conditions (ie  $V$  continuous across boundary)

$$V = \frac{5ka^2}{c \epsilon_0}$$

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Region 2  $a < r < b$ 

$$\vec{E} = \frac{5ka^2}{r^2 \epsilon_0} \hat{r}$$

$$V = -\int \vec{E} \cdot d\vec{l} = -\int \frac{5ka^2}{r^2 \epsilon_0}$$

$$V = \frac{+5ka^2}{r \epsilon_0} + C_1$$

at  $r=b$ 

$$V = \frac{5ka^2}{c \epsilon_0} = \frac{+5ka^2}{b \epsilon_0} + C_1$$

Region 2  $a < r < b$

Part A: Problem 1 (3)

$V$  (continued)

at  $r=b$

$$V = \frac{5ka^2}{c\epsilon_0} = \frac{+5ka^2}{b\epsilon_0} + C_1$$

$$C_1 = \frac{5ka^2}{\epsilon_0} \left[ \frac{1}{c} + \frac{-1}{b} \right]$$

$$\therefore V(a < r < b) = \frac{+5ka^2}{r\epsilon_0} + \frac{5ka^2}{\epsilon_0} \left[ \frac{1}{c} + \frac{-1}{b} \right]$$

Region 1

$r < a$

$$\vec{E} = \emptyset$$

$$V = -\int \vec{E} \cdot d\vec{l}$$

$$= C_2$$

Solve for  $C_2$  at  $r=a$

$$V(r=a) = \frac{+5ka}{\epsilon_0} + \frac{5ka^2}{\epsilon_0} \left[ \frac{1}{c} + \frac{-1}{b} \right] = C_2$$

$$C_2 = \frac{5ka^2}{\epsilon_0} \left[ +\frac{1}{a} + \frac{1}{c} + \frac{-1}{b} \right]$$